This is to certify that the

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MULTIMEDIA AS A SUPPLEMENT
FOR TEACHING A PACKAGING SUBJECT

presented by

Romont Jones

has been accepted towards fulfillment
of the requirements for

M.S. degree in Packaging

Harold Hughes
Major professor

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MULTIMEDIA AS A SUPPLEMENT FOR TEACHING A PACKAGING SUBJECT

By

Romont Jones

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
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AN ABSTRACT OF A THESIS

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ABSTRACT

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Computers are used extensively in teaching to manage assessment and test information, such as: collecting and processing data, and providing communication functions. Use of computers to present multimedia as a tool for instruction is less common, but the benefits of using computers to assist in instruction are being increasingly recognized by instructors at various levels of the education process. In the project discussed in this thesis, an animation of the corrugated paperboard manufacturing process, along with associated materials, were developed and recorded on a CD-ROM. The effectiveness of the presentation on the CD-ROM was evaluated by showing portions of the program to selected individuals and then administering a questionnaire designed to collect information about the mode of presentation and effectiveness as a teaching tool in classroom settings or when used privately by the individual.

Four age groups were targeted for this study. The majority of the participants were college students. Data sheets were used to record the students' responses to the questionnaire. When asked if the program helped them visualize the subject matter better, 39 of the 71 subjects (55%) "strongly agreed".

ACKNOWLEDGEMENTS

I would like to thank my wonderful wife, Manika, for being there when I needed someone to proofread my material, for lending your beautiful voice on the narrations and for helping out with the recording process. I can never re-pay you for supporting me when I wanted to give up and giving me a reason to continue. Without your help, I would not have been able to accomplish half of the things I presently have. I truly love you and you are my best friend.

Thank you to my immediate family (Robert, Uverlene, Sunta, and Tatika Jones) for your constant support during my collegiate studies. Without that support both financially and emotionally, I would have faced even more difficult times before accomplishing my goal. I love you all.

I would like to take this opportunity to officially thank my major professor, Dr. Harold A. Hughes. Dr. Hughes was always available and supportive throughout this endeavor. Anything I needed, be it scheduling plant tours, signatures for administrative work, or equipment, he was always ready to help. And at no time did he state that my thesis goal could not be accomplished.

I would like to thank my committee members, Dr. Bruce Harte, and Dr. Joseph J. Kuszai. Just like Dr. Hughes, Dr. Harte was always eager to listen and help with any problems or situations that arose. Dr. Kuszai has to be one of the most creative individuals I have ever encountered. It was in his multimedia class that I realized that this project could be accomplished. His "out of the box" thinking helped me to look past the norm and to see the many possibilities of my talents.

I can not mention multimedia without thanking my friends at the Faculty Facility for Creative Computing (FFCC), and the Digital Media Arts and Technology lab (DMAT). James and Marc, who run the FFCC lab, always knew how to solve all of my technical questions. Also, thanks to the many directors, computer lab assistants, and communication art students that provided me with their unlimited knowledge. I am glad that I got a chance to befriend all of you. You will always be remembered.

To my fraternity brothers of Omega Psi Phi Fraternity – Sigma Chapter (D.O.A. 4-4-92) and my many friends. I would like to thank you for the many good times we shared and hopefully we will continue to share many more in the future.

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Chapter 1

INTRODUCTION

Halal and Liebowitz (1994) stated, "The key technology in future education will be interactive multimedia - a powerful combination of earlier technologies that constitutes an extraordinary advance in the capability of machines to assist the educational process." Interactive multimedia combines hardware, software, and peripheral equipment to provide a rich mixture of text, graphics, sound, animation, full-motion video, data, and other forms of information.

Interactive multimedia has several key characteristics that can support traditional teaching methods:

- Students can receive training when and where they need or want it. An instructor does not have to be present, so students can select the time best suited to their personal schedules.
- Students can adjourn the training process at any point in a lesson and return to it later.
- The teaching can be highly effective because it is based on powerful principles of individualized learning. A student who finds a program to be interesting sticks with it. Retention of the material learned is often excellent.
- The same equipment can be used to support a variety of training paths, individual or group.
- The ability to control the learning experience makes the student an active, not passive, learner.

The introduction of multimedia technology into the teaching process in higher education provides an opportunity and a requirement to reconsider teaching strategies. The strategy reconsideration should address the opportunities for promoting the efficiency and effectiveness of learning through the use of this new technology.

Millions of people, literally, are currently being trained quickly, effectively, and inexpensively using multimedia systems at Hewlett-Packard, Apple, Daimler-Chrysler, Shell, Xerox, Ford, and other companies, and by the U.S. government, particularly the military. "Multimedia is the preferred method of training" Kenworthy(1994).

Hewlett-Packard has used multimedia to eliminate 90 percent of its former classroom training. In a similar fashion, Apple Computer has reduced conventional classroom training by 75 percent, Carter (1994).

Studies of these programs show that learning time is shortened by 50 percent, retention is increased by 80 percent, and costs are cut in half through the use of computerized multi-media, Carter (1994).

The development of computerized multimedia teaching materials for use in higher education has often been driven by the desire to increase teaching efficiency or productivity. Numerous courseware packages have been developed, primarily to replace or supplement conventional lecture style teaching. The interactive capabilities of computerized multimedia allow the courseware to be adapted to the specific needs and abilities of individual students. A student can study and learn whenever it best suits him or her.

The pace of a structured class is often too fast or too slow to suit particular students, since individuals comprehend material at different rates. Most instructors attempt to find a "middle ground" to set the pace. Unfortunately, that "middle ground" is unsatisfactory for most of the students, too fast for some to comprehend the material and too slow for others who often find the process to be somewhat boring. Multimedia teaching technology does not have to operate at a preset speed. The student/learner controls the presentation, selecting a subsequent topic or menu item when ready. Students can replay videos and animations or re-read text passages until they feel comfortable with the material.

Conventional classroom training will continue to be used in higher education, at least for clarifying and resolving problems, but interactive multimedia training should become a common and familiar teaching process. Improved visualization of subjects, enhanced information retention, and improved time management are just a few of the advantages that will drive the conversion process, Hughes (2000).

Multimedia instructional systems are becoming more powerful and user-friendly and less expensive. These are valuable system traits for schools, governments, and corporations that are searching for better ways to educate people. It is easy to envision multimedia systems finding wide use in learning situations that occur throughout life, such as:

- teaching well-defined subjects such as language, math, and science
- guiding technicians and mechanics through complex repair or construction jobs

- helping surgeons learn new operations and procedures
- acting as automated sales offices where customers can get information
- operating registration booths where college students can conveniently register for classes
- performing countless other information-handling tasks.

As yet, multimedia instruction systems have not been successful in replacing traditional instruction on a large scale, Halal and Liebowitz (1994). The lecture continues to be the main teaching method used in higher education, but many teaching professionals argue that multimedia based technology will be the future of education.

The project discussed in the remainder of this thesis provided information that supports that prediction. Multimedia based materials were developed to be used in teaching one segment of an introductory course in packaging. The materials, developed for use in a lecture situation, could easily be adapted to an individualized instruction mode.

The fundamental goal of the project was to evaluate the effectiveness of multimedia technology as an aid in teaching about the manufacturing and use of corrugated paperboard to beginning level packaging students and others in PKG 101, the "first course" in packaging.

Specific objectives of the project included:

1. To develop a multimedia presentation on the topic of corrugated board to make the topic interesting and engaging for the student learners.

2. To prepare the multimedia materials in a CD-ROM format that can be conveniently distributed to assist and support students to learn about the use of corrugated board in packaging.
3. To determine if the presentation details of the materials (graphics, colors, orientation, etc.) were suitable for students in PKG 101.
4. To determine if students in several age groups thought the multimedia material on the CD-ROM was "user friendly".
5. To determine if students thought that the classroom multimedia presentation would assist them to learn about corrugated board.

Chapter 2

LITERATURE REVIEW

Information presented in this thesis builds on earlier studies done on interactive compact disc modules, multimedia, and other computer based teaching systems.

Beerman, Brown, and Evans (1996) developed an educational program on a compact disc for use in a Food Science and Human Nutrition course. Their research, "Interactive CD Study Modules in Food Science and Human Nutrition: Assessing Technology-Enhanced Study Programs" was designed to help frame a more productive context from which to examine the influence of new teaching technologies. Specifically, the study examined the integration of a CD-ROM study aid into a large lecture classroom curriculum to supplement the textbook and lecture.

They tested 263 students in two human nutrition courses. One hundred and twenty nine (129) students studied the material via CD-ROM in a computer lab. The length of time that each student used the CD-ROM was determined by recording the times that each student checked in and out of the lab.

The other student group was assigned readings from their textbooks and attended three lectures per week. All subjects were instructed to complete their assigned module in one week.

Students enrolled in section one of the course completed a module on digestion / absorption. Students in section two completed two modules, covering carbohydrates and lipids. Three exams, consisting of 30 multiple-choice

questions, were administered during evenings so that both sections received their test the same time.

For those questions related to the material available on the CD-ROM, test scores were 2.8 percentage points higher for the CD-ROM treatment group than the No-CD-ROM treatment group. Of the students surveyed, 51% reported that using a CD-ROM enhanced their understanding of class material, and 54% reported that they enjoyed learning by using an interactive CD-ROM.

Mobley (1994) dealt with interactive multimedia in a music classroom setting. The music material was being field-tested on CD-ROM to evaluate the user friendliness of the technology. The music class had 31 students with a variety of majors. There were no music majors in the class.

At the beginning of the academic session, the lecture notes and programs were loaded onto the hard drives of computers at the Bainbridge College Library in Bainbridge, Georgia. Students could access the materials by simply inserting the appropriate CD. Each student then proceeded at his or her own pace. There was considerable agreement in the student's evaluations that the technology held their interest very well. Students could use a computer to review the classroom presentations and other CD-ROM programs that were hosted on computers in the library.

Reynolds (1996) experimented with multimedia while teaching a history survey class (composed mostly of freshmen) at the University of Texas at San Antonio. The use of multimedia in the lecture course did not require radical pedagogical changes. Reynolds taught the class in the conventional lecture

format, with the aid of animation, cartoons, maps, hot-words and other multimedia tools.

The application of multimedia was limited, but it did appeal to the students. Most programs which demonstrated the utility of multimedia have focused on the "interactive" mode, but Reynolds' study showed that, even in the passive lecture format, the outlines, graphs, and other visual aids enhanced the educational experience.

An informal survey was given to 255 students. When asked, "If they had to take another history survey course, would they prefer to have it taught with multimedia?", a majority of students (62.7%) wanted their next history course to be taught with multimedia.

Reynolds stated that the use of multimedia caused him to take pride in his handiwork and that he was more enthusiastic and animated in discussing topics in class. Multimedia had a positive influence on his classroom performance and on the students' subsequent evaluations of his teaching. Given this example, one could speculate whether multimedia is of greater benefit to the students or the instructor.

Andersen Consulting (1994) is a worldwide firm with over 40,000 employees in 47 countries. Before adopting multimedia approaches, the firm's main training center in St. Charles, Illinois, delivered thousands of hours of classroom instruction, but the cost and productivity loss associated with travel for training were a significant organizational issue. This concern led the

Professional Education Division to investigate the use of interactive multimedia for self-study, "point-of-need" learning.

An initial effort was the conversion of a 65-hour instructor-led "Business Practice" course into a 40 hour multimedia program, consisting of 15 modules distributed in CD-ROM format. The program includes a simulation and features video segments for briefings and interviews with employees as well as working models of the key functions (e.g., sales, product development, cash management, etc.) in a company.

The value of the new business practice course was summarized by Acovelli and Nowaskowski (1993), as follows: "In a traditional classroom setting or in paper-based self-study, tasks are often isolated from one another and from a realistic context. On the job, consultants should be able to understand how the people and the processes of a client interrelate. Consultants should be able to see connections and determine effects as they are gathering information; it should be a seamless process. Effective learning systems, then, are those designed to make learning more valuable by simulating tasks that have the look and flow of those in the real world. Interactive multimedia computer learning systems can do this."

The use of the multimedia course saves Andersen Consulting an estimated $10.5 million annually in travel costs.

These findings indicate that a thoughtful and informed approach to the development of supplemental material can significantly enhance student

performance. There is no evidence that supplemental material should not and cannot be multimedia.

Statements of Benefits

When a structure of linked elements through which the learner can navigate is provided, learning with interactive multimedia becomes both enjoyable and exciting, Blackwell (1997). Statements from teaching professionals reinforce the suggestion that multimedia is a beneficial teaching tool. Blanco (1996), uses hypercards and native speakers' recorded voices to teach Spanish speaking students to divide words into syllables and identify strong stress in words.

He stated that multimedia placed his students in non-threatening positions, because he was not looking over their shoulders to see if they were doing something correctly or not. The students did the exercises at times that were convenient for them as individuals. Another plus, Blanco stated, is that he, the instructor, was able to do much of his own work at home, by simply logging on to the server, getting files, editing files, and putting files back on the server so that the students can have access to them.

Abraham (1996), discussed the teaching of biomechanics in a Kinesiology course. His course covers the relationships among spatial and temporal movement patterns and the forces that produce movement. In the past, films and stop action video were used to capture these relationships. Abraham suggests that, for people to effectively understand the intricacies of movement,

three-dimensional representation is needed to show location and shading. Multimedia software easily conveys this message by using moving images, graphics, and sound.

Marshall (1996), uses multimedia in a "Biological Basis of Behavior" course. He stated that multimedia is the least expensive, most effective way to illustrate concepts and objects.

His course focused on the structure and function of the brain, the central nervous system, and the peripheral nervous system. Without multimedia, the instruction required the use of specimens, usually sheep brains. Unfortunately, the brains were easily damaged when used in a classroom, so it was necessary to have a ready supply of replacements available. Animal rights activists objected to the use of sheep brains. Actual human brains were even more costly and difficult to procure. Marshall stated that multimedia was, by far, less expensive and provided more accurate information than working with real brains. Illustrations of the brain and the central nervous system were scanned and magnified, showing details that may not be visible by the naked eye.

Marshall noted that multimedia was readily accessible to students. Students could leave class and two days later take their notes back to the data banks, and go through the illustrations used for a particular lesson, making it easier to review for tests or re-formatting notes.

Rivera (1996), used multimedia for teaching Special Education topics because it made learning more exciting. Rivera noted that multimedia offers students a variety of instructional material. The instructor can incorporate both

visual and auditory information. Capturing specific concepts via imported movies is just one example of how an instructor could make materials more "alive" by using visual imagery.

Rivera also used multimedia to give students an opportunity for hands-on activities. Rather than simply sitting passively and reading a textbook, students interacted with the multimedia material. For example, the students clicked on icons to navigate through questions and answers that were being presented.

Questions were incorporated into a program on a CD for students to consider before they began an activity and after it had been completed. The teaching professional could quickly check for improvement in understanding after the completion of the exercises.

Reyes (1996), in an educational administration course, used multimedia to instruct school principals about presentation methods. He placed multiple digital developmental programs onto the database at a digital media center. The software incorporated sound, text, and motion into one presentation. The programs were selected because they showed the principals how presentations can be generated.

By using interactive software, the principals learned more than they would have by simply listening to a typical university lecture. Reyes stated that research shows typically individuals retain only about 10-15% of what they hear, so the courses are designed with major emphasis on audio. The principals worked with problems and technology simultaneously to formulate answers,

bringing in theories and literature to enhance the potential solutions to the problem.

Other Opinions and Facts

Perdue (1998) stated that multimedia is not really "NEW". However, the use of multimedia has changed dramatically. Multimedia has "gone digital".

Pictures, sounds, text, and even movies can now be stored digitally rather than in analog form. This transition is a significant leap, because digital storage makes the information easy to edit, easy to control, and easy to move. Consider for example, the process of editing a video.

In analog form, editing is a laborious task that involves the use of two VCR's and a lot of viewing, winding and rewinding. Using the digital process, the same task may require only a few clicks of a mouse button. In modern multimedia, all of the media elements can be stored in one place (a personal computer) and can be choreographed using increasingly intuitive software. Today, the development of multimedia lectures no longer requires an "army" of assistants.

In the digital age, the ease of working with multimedia is likely to make it pervasive. An analogy is the transformations that have occurred since the advent of desktop publishing. Today, anyone with a computer can become a publisher. Similarly, the appropriate technology will allow any instructor to become a multimedia producer.

The following are additional interesting statements about multimedia use:

People only retain 20% of what they see and 30% of what they hear, but they remember 50% of what they see and hear, and as much as 80% of what they see, hear, and do simultaneously.

If used properly, interactive multimedia excels in leaving lasting impressions in the teaching/learning process. Retention rates increase by 25% to 50%, (Computer Technology Research, 1993).

Winter (1993), stated: "Multimedia is a synthesis: a hybrid offering the advantages of the user-driven book with the wonders of electronic technology."

Hofstetter (1997), suggested: "Multimedia Networks add an important dimension to educational computing. Multimedia computing and the Information Superhighway are linking universities, colleges, schools, and homes into a continuum that is breaking down the distinction between grade levels. Students can collaborate on worldwide projects. The benefits of multimedia reduce learning time, and achievement levels are more than a standard deviation higher (a full letter grade in school)".

Chapter 3

MATERIALS AND APPARATUS

Software

The work reported in this thesis was produced through the use of several software packages and appropriate computer hardware. The following section discusses the capabilities of each program and device that was used.

Adobe Premiere ©

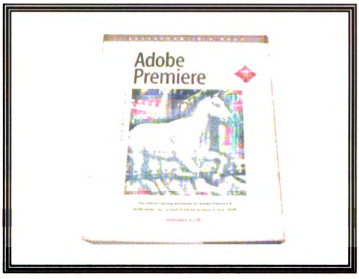
Adobe Premiere allows a user to combine source material, or clips, to make a movie, and then view and play the movie using any application that supports the Quick Time movie format. (Figure 1) The Adobe Premiere movie, a file created after assembling and editing clips, can include the following:

- Digitized video captured from cameras, VCRs, or tape decks
- Quick Time movies made using Adobe Premiere or other software
- Animations
- Scanned images or slides
- Digital audio recordings and synthesized music and sound
- Adobe Illustrator files
- Adobe Photoshop files
- Film strip format files created in Adobe Premiere and edited in Adobe Photoshop
- Titles
- Backgrounds

Several digital devices are available to create video and audio clips. The information can be recorded onto the hard drive of a computer.

FIGURE 1

PHOTO OF ADOBE PREMIERE SOFTWARE

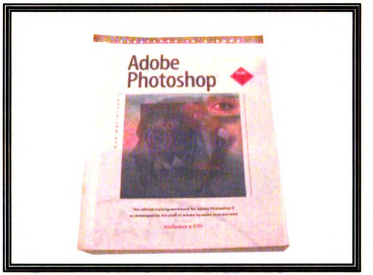


Adobe Photoshop ©

Photoshop (Figure 2) is an integrated program that can be used to edit digital or scanned images. The Adobe Photoshop software uses copying, cropping, re-sizing and other techniques to give an amateur user professional quality results.

FIGURE 2

PHOTO OF ADOBE PHOTOSHOP SOFTWARE



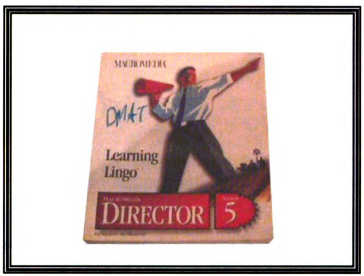
Director 7.0©

Director assists an operator to combine graphics, sound, animation, text, and video to create professional, interactive material that is easy to deploy on CD-ROM, DVD, or the World Wide Web(WWW). (Figure 3)

Using software like Adobe and Lightwave 3D, Director 7.0 combines files and places them in a format that gives the user the ability to interact with sound, graphics and video. The user is able to navigate through the material and have control of the speed in which they digest the material.

FIGURE 3

PHOTO OF DIRECTOR 7.0 SOFTWARE



Lightwave 3D©

Lightwave 3D is a software package which allows creation of realistic three-dimensional (3D) images and animations on a Macintosh computer system. (Figure 4) Lightwave 3D gives the user the ability to create objects, such as a table and chair made of oak, or a company's logo carved out of gold.

Lightwave 3D can be used to create animation in which the motion of each object can be controlled by the user. Lights, cameras, and morphing effects (one shape changes into another) are just a few other techniques that Lightwave lets the user manipulate.

Figure 4

PHOTO OF LIGHTWAVE 3D SOFTWARE

Hardware

A variety of hardware was selected to accomplish the goal of preparing the interactive CD-ROM.

Macintosh Computer

The Macintosh computer was the central system that was used to combine all of the products of the software and hardware. This system was chosen because the majority of the software used was Macintosh based. (Figure 5)

FIGURE 5

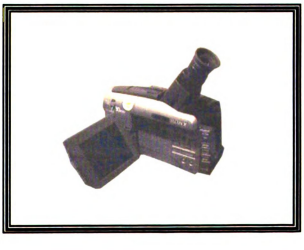
PHOTO OF MACINTOSH COMPUTER

Sony 8mm Camcorder

While doing the corrugated board testing, (Edge / Flat Crush Resistance, Mullen Burst, Compression Strength, and Puncture Resistance), a Sony 8mm Camcorder was set up on a tripod to record the activity. (Figure 6)

FIGURE 6

PHOTO OF SONY 8mm CAMCORDER

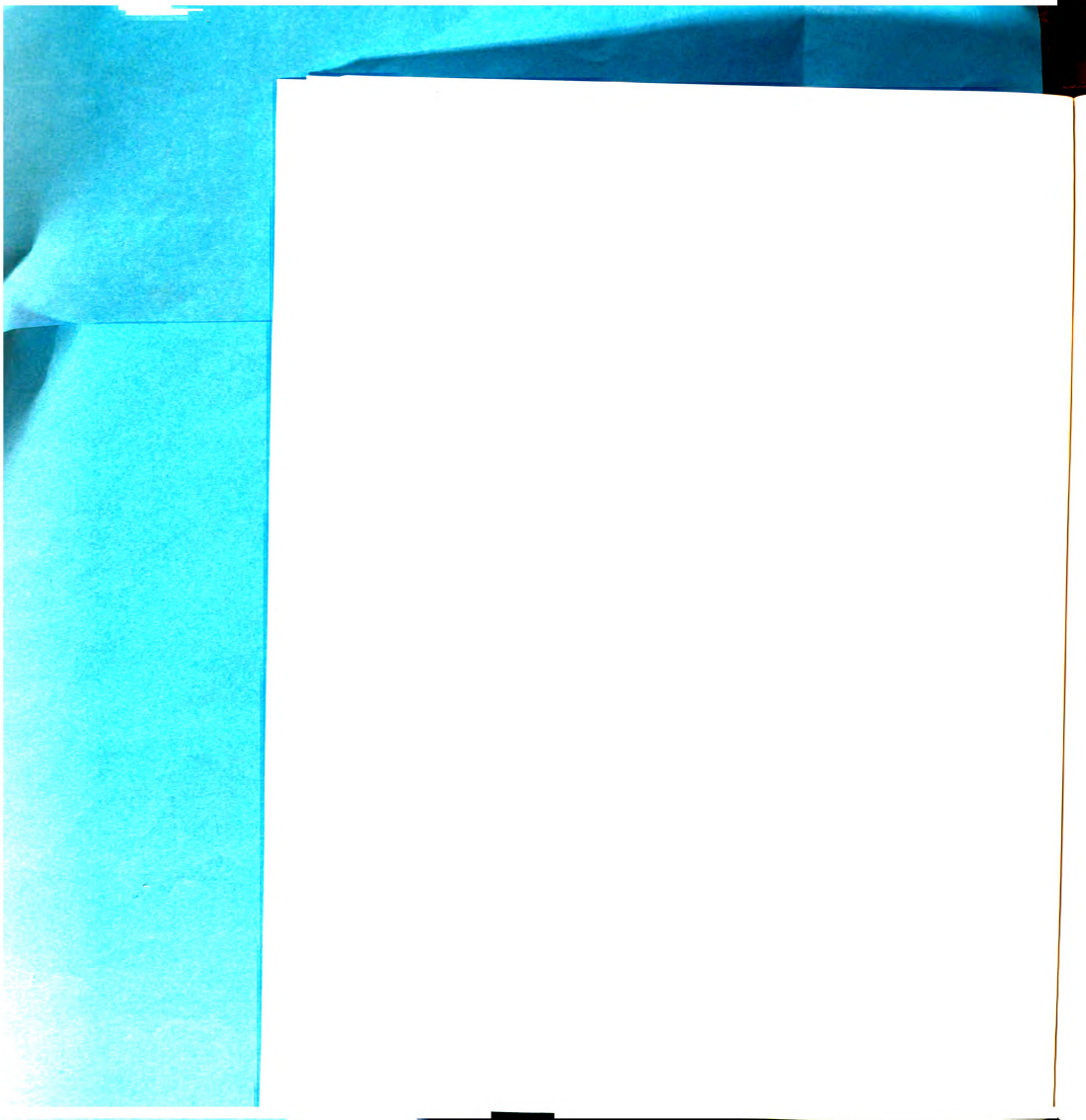


Sony Digital Camera / Polaroid Camera

A Sony Digital camera and a Polaroid Camera were used to take photos. (Figure 7) Research materials were photographed from booklets and magazines, during plant tours, and testing procedures.

FIGURE 7

PHOTO OF SONY DIGITAL CAMERA



Macintosh Flatbed Scanner

A Color One flatbed scanner was used to scan photos taken from periodicals. (Figure 8) Original Polaroid photos were also scanned into digital files to be edited at a later date.

FIGURE 8

PHOTO OF MACINTOSH FLATBED SCANNER

HD Floppy Disk / Iomega 100 Zip Disk

Digital photos were saved directly onto standard HD floppy disks. (Figure 9) After editing, the digital images were saved onto a 100 Mb Iomega Zip disk. The zip disks were selected because of their higher storage capacity. One Zip disk holds about the same amount of data as 75 conventional floppy disks.

FIGURE 9

PHOTO OF IOMEGA 100 ZIP DISK

Sony VCR / Maxell 8mm Videotapes

Images taken with the video camera were placed on Maxell 8mm videotapes and then downloaded to zip disks using a Sony VCR. (Figure 10) The VCR was utilized to replay the captured movies on the Macintosh computer for final editing.

FIGURE 10

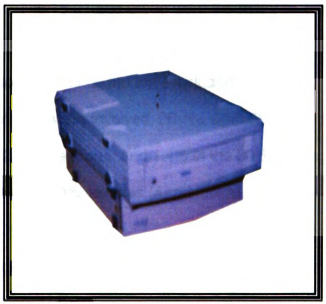
PHOTO OF SONY VCR

CD Burner / CompUSA Recordable CDs

The images, graphic files, videos, animations, and audio were "burned" onto CDs by using a Yamaha CRW4260 CD Burner, a Macintosh computer, and a software program called Video Toaster. (Figure 11)

FIGURE 11

PHOTO OF CD BURNER



All of the software and hardware was used to produce the program that was finally converted onto a compact disc for testing.

A group of subjects were selected to evaluate the materials on the compact disc. The program from the compact disc was displayed in a presentation form in a classroom. The presentation was conducted by using an overhead projector to show the CD-ROM program to the group.

The PKG 101 instructor assisted with the recruiting of these test subjects. The presentation was conducted in a lecture hall. All sections of the CD-ROM

were presented in dim light, to enhance the color and graphics of the multimedia material for the subjects.

The test subjects consisted of a variety of people of different backgrounds. Their demographics are what enhanced the test results.

Test Group Demographics

Initially, four age groups, 18-21; 22-25; 26-29; and 30 & over, were targeted for this study. The 18-21 age group were the majority. Each group was primarily composed of undergraduate students at Michigan State University, although there were some graduate students included.

A total of 71 subjects were involved. There were 85.9% in the 18-21 age group; 12.7% in the 22-25 age group; and 1.4% in the 30 & over age group. There were 69% males and 31% females (Appendix A).

Multimedia Program Content

The program development process started with the development of the main menu that presented topic headings listing the content and also presented the "flavor" of the subject matter. The image of an open corrugated box with partitions to separate the icons that represented various topics was used to satisfy these requirements.

The first subject, ***INTRODUCTION***, displays various graphics and fonts that can be utilized on packaging. The gliding photos are a good example of this, while the audio informs the user how packaging is a so-called "Silent Salesman".

The next topic, ***MSU-THESIS,*** orients the user to the program on the CD-ROM and discusses its relationship to the thesis. Three-dimensional imagery was constructed to show how packaging is a global force. An audio track incorporated into the presentation explains how a multimedia presentation on a CD-ROM can aid the learning process.

Another section is the ***HISTORY OF PACKAGING***. This section explains the chronological history of corrugated board. A scroll bar was incorporated so that the text could be viewed at a speed that suited the reader. Reading the text can be done while simultaneously viewing the images. By doing this, the user can get a better understanding of the historical process.

The next section, ***3D PLANT***, consists of three sections. The first section focuses on the machinery and equipment. A list of the various machines used to make corrugated board is displayed. Selecting a particular machine causes a screen to be displayed that includes a brief description of the machine (i.e. height, weight and operating speed). A three-dimensional image of the machine accompanies the text. The image can be rotated by the user to view the machine from different angles (0-360°).

The second section deals with information about corrugated board. For example, the various grades of corrugated board are described and defined:

- **A-flute:** avg. flute height = 4.8mm
- **B-flute:** avg. flute height = 3.0mm
- **C-flute:** avg. flute height = 3.9mm
- **E-flute:** avg. flute height = 1.8mm

This section includes a discussion of the way that the corrugated board can protect products in various situations. For example, corrugated board can protect a product from damage caused by dropping. The flutes in the corrugated board act as cushions, collapsing to absorb energy when packages are dropped.

The final section is a three-dimensional plant tour. This section combines audio and 3D graphics to show how the various machines work together to produce corrugated board. As the audio explains each piece of equipment, the user can click through the process. The intent is to make it seem as though the user is walking through an actual corrugated plant.

The next section on the main menu is ***MATERIAL TESTING***. This takes the user through selected test that are conducted on corrugated board. ***MATERIAL TESTING*** breaks further into four sections.

•*Mullen Burst Test*

The text on the process explains how a rubber diaphragm bursts a 12"x12" sample of corrugated board, and displays the data in pounds per square inch (psi). A video of the process can be played if further understanding is needed.

•*ECT and FCT Test*

Edge Crush Test(ECT) and Flat Crush Test(FCT) are somewhat related because of the equipment used. The ECT uses a small 2"x 2" sample of corrugated material, set upright in the testing machine, and yields results in the

form of pounds per two inch (#/2in). The stacking strength of a box can be estimated from the data.

The FCT uses a corrugated sample that is $10in^2$ in diameter and is placed flat in the machine. The air between the flutes is squeezed out, the flutes are checked for "roll-over", and the data is recorded in pounds per ten square inches ($\#/10in^2$). This section is also includes an optional video of the step-by-step process.

•Puncture Test

The puncture test uses 12"x12" samples of corrugated board that are punctured by a swinging pointed arrow. The readings are given in Beech-Units that are converted into inch-pounds (in-lb). A video segment is used to show an example of the test.

•Tests done on a Compression Machine

The text explains how actual boxes can be compressed, giving the user force (lb) and deflection (in) data. The compression data can be used to determine the stacking strength of the box.

The last icon on the main menu is the ***QUIT*** button, which is self-explanatory. When ***QUIT*** is selected, the program automatically scrolls through the credits, including the names of people associated with the development of the CD-ROM. When complete, the program stops and gives the user the option to: Start again, Exit the program, or View the bibliography.

Procedures for Data Collection

Interactive multimedia combines hardware, software, and peripheral equipment to provide a rich mixture of text, graphics, sound, animation, full-motion video, data, and other forms of information. This process makes the information more enjoyable to learn and gives the user the ability to control the speed of the learning. This and if individuals could retain any information by using interactive software, are just a few of the factors why this test was conducted. As times change so to will technology, and for this reason only a selected group were shown the CD-ROM presentation. Ideally the material within the CD-ROM can be updated with newer multimedia information and conducted on other students for further results. But for the present time the experiment went as follows:

Four groups of students were tested. The materials were presented in a classroom setting by using a Power Macintosh Computer and a Digital Overhead Projector. The subjects were enrolled in PKG 101 at Michigan State University, spring semester 2000. The test was conducted in a lecture hall that was dimly lit to enhance the visibility of the visual images, graphics, and animations.

Orientation

Prior to testing, test subjects were provided with a brief orientation presented by the author. The subjects were informed about the steps that would be taking place for the data collection.

Following the discussion of the procedures taking place, the researcher explained the expected benefits of using multimedia in a classroom setting. If the subjects chose to participate in the study, they were informed that they would be asked to fill out some information regarding their education, age, sex, and questions about the presentation. They were assured that the information would be anonymous; their names would not be recorded on any documents; and that the testing would not take longer than 20 minutes.

To protect the test subjects' rights, they were asked to review a written consent form attached to the questionnaire. Participation was voluntary; subjects could refuse to answer certain questions or discontinue the experiment at any time without penalty. (See Appendix B)

Collection of Subject-Related Information

A data sheet was used to record information provided by the subjects. (See Appendix C) The subjects noted their college major, age, and sex.

After background information was recorded, subjects viewed a digital projection of the interactive CD-ROM. While seated, they were asked to answer eight questions. The researcher guided the subjects through certain parts of the CD-ROM, while narrating the written text, showing pre-determined sections of animation, audio, text, and video, to give the subjects a feel for the CD-ROM's content.

The subjects' responses for each of the eight questions were recorded on their data-recording sheet. This data was later tabulated and analyzed.

Chapter 4

RESULTS

The questions and results of the student survey are explained below. Students were asked to either strongly agree, generally agree, neither agree or disagree, generally disagree, or strongly disagree:

1) **"The program was clear and easy to use."**

Students considered the programs clarity to be a useful characteristic: 44% "strongly agreed" and a total of 89% "agreed" that the clarity was an important issue related to the multimedia material. (See Appendix D)

2) **"The program would be a good supplement for aiding lectures."**

The proposition that multimedia can help teaching is also supported by the survey; 47% of the students "strongly agreed" and a total of 89% "agreed" that the program could assist in lectures. (See Appendix E)

3) **"The program was more useful than the textbook."**

Thirty-eight percent (38%) of the respondents "strongly agreed" and a total of 70% "agreed" that the multimedia material could, in some way, be more useful than the text book. (See Appendix F)

4) **"Similar programs should be developed to illustrate the**

operation of metal film testing, robotic pallentization, film application, and related topics."

More than 42% of the students "strongly agreed" and a total of 87% "agreed" that the multimedia program should have different versions related to other packaging engineering subjects. (See Appendix G)

5) **"The program should be used to present the topic of corrugated board to future classes in PKG 101."**

Thirty-nine percent (39%) of the respondents "strongly agreed" and a total of 76% "agreed" that the multimedia program could be used if improved in certain aspects. (See Appendix H)

6) **"The program helped me visualize the operation of the corrugator better."**

In what is perhaps the best overall assessment of student opinion on the subject, 55% of the students "strongly agreed" and a total of 87% "agreed" that the program helped them visualize the operation of a corrugator. (See Appendix I)

7) **"I was better able to understand the operation of a corrugator after watching the program."**

Of the seventy-one forms returned, forty-three percent (43%) "strongly agreed" and a total of 81% "agreed" that they better understood the

operation of a corrugator after the program was presented. (See Appendix J)

8) "I had trouble understanding the concepts before I saw the program."

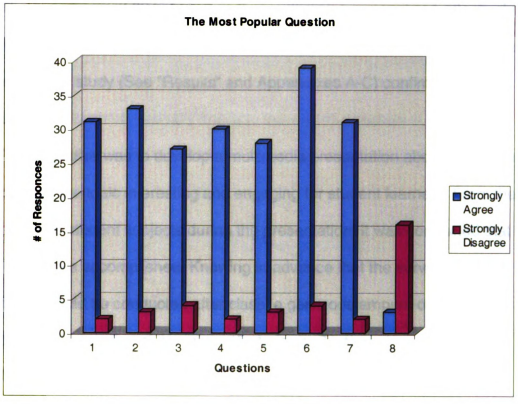
Out of the total surveys 4% "strongly agreed" and a total of 11% "agreed" with this statement. This percentage is low, but it corresponds greatly with the fact that even though subjects are educated on a subject, multimedia can still improve their understanding and visualization of that subject. (See Appendix K)

Figure 12 was created by adding the number of responses for each question and generating a bar chart between the questions most "strongly agreed" upon and the ones most "strongly disagreed" upon. By grouping the data in this fashion, the most popular question and less popular question can be examined.

For instance, although the general idea would be to use the multimedia program to replace the textbook (Question #1), by examining the graph it becomes evident that replacing the textbook is minor when compared with visualizing the subject matter better (Question #6).

Conversely, subjects "strongly disagreed" that they had problems understanding the concepts before hand. (Question #1) There are several possible explanations for these differences, which will be discussed in the "Conclusions and Recommendations" section.

FIGURE 12


The Most Popular Question
# of Responces
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
Questions
Strongly Agree
Strongly Disagree

CONCLUSIONS

The hypothesis of this study was that multimedia material can effectively aide in teaching packaging subjects to students. The data collected answers the objectives of this study (See "Results" and Appendixes A-C) confirming this hypothesis.

One objective was to develop a multimedia presentation about corrugated board to make the topic interesting and engaging for student learners. From the response of the student subjects during the presentation, it was concluded that this objective was accomplished. Knowing in advance that the survey and presentation would be conducted after class, a generous amount of students stayed to participate. Out of the total 185 students, 71 stayed.

Another objective was to prepare the multimedia material in a CD-ROM format that could be conveniently distributed to assist and support students to learn about the use of corrugated board in packaging. This was accomplished by using software and hardware to produce the final product.

The next objective, "To determine if the presentation details of the materials were suitable for students in PKG 101", was answered in the survey question #1. Forty-four percent (44%) of the student subjects "strongly agreed" and a total of 89% "agreed" that "The program was clear and easy to use".

The other objective, "to determine if students in several age groups thought the multimedia material on the CD-ROM was "user friendly" was simultaneously answered with the previous objective in question #1 of the data survey.

The final objective which stated "to determine if students thought that the classroom multimedia presentation would assist them to learn about corrugated board", was also answered by the data survey. Thirty-seven percent (37%) "generally agreed" that the multimedia presentation should be used.

This last objective basically answers the overall objective of the thesis, which was to determine if the multimedia technology could be used to enhance the instruction of packaging technology.

Chapter 5

RECOMMENDATIONS FOR FUTURE STUDY

The following activities are suggested to extend and build upon the work reported in this document.

1) A study aimed at different higher education subjects on CD-ROM is advised.
2) A study comparing the effects of studying with a CD-ROM versus a textbook is advised.
3) A study investigating the effectiveness of learning a subject strictly via CD-ROM is advised.

APPENDIX

A

Age Group	Number Amount
18-21	61
22-25	9
26-29	0
30 and Over	1
Total Students:	71
Sex	**Number Amount**
Male	49
Female	22

APPENDIX

B

CONSENT FORM

This survey will help in the collection of data for the study of using multimedia material as a tool to effectively aide in teaching educational topics to students in a 100 and/or 300 level class.

Participation is voluntary; subjects may choose not to participate at all. Subjects may refuse to answer certain questions or may discontinue the experiment at any time without penalty or loss of benefits which the subject is otherwise entitled.

The estimated time for this survey is 20 min. Subjects will remain anonymous in the reporting of research findings. On request and within these restrictions, results may be made available to subjects. **(Your privacy will be protected to the maximum extent allowable by law)**

In case of any questions or concerns, contact Romont Jones 355-5924 or Prof. Harold Hughes 353-6462. For questions about your rights as human subjects of research, direct them to UCRIHS Chair: David E. Wright 355-2180.

(You indicate your voluntary agreement to participate by completing and returning this questionnaire.)

APPENDIX

C

Survey Sheet

(THIS SURVEY IS A VOLUNTARY ACTIVITY. YOU DO NOT HAVE TO PARTICIPATE)

Age Group: 18-21 ☐ 22-25 ☐ 26-29 ☐ 30 and over ☐

Sex: Male ☐ Female ☐

Education: Undergraduate ☐

Graduate ☐

College Major (If Selected): _____

Please rate the following statements from 1 to 5, using the following definitions:

1 – Strongly Disagree
2 – Generally Disagree
3 – Neither Agree or Disagree
4 – Generally Agree
5 – Strongly Agree

Rating

1) The program was clear and easy to use. —

2) The program would be a good supplement for aiding lectures. —

3) The program was more useful than the textbook. —

4) Similar programs should be developed to illustrate the operation of metal film testing, robotic palletization, film application, and related topics. —

5) The program should be used to present the topic of corrugated board to future classes in PKG 101. —

6) The program helped me visualize the operation of a corrugator better. —

7) I was better able to understand the operation of a corrugator after watching the program. ___

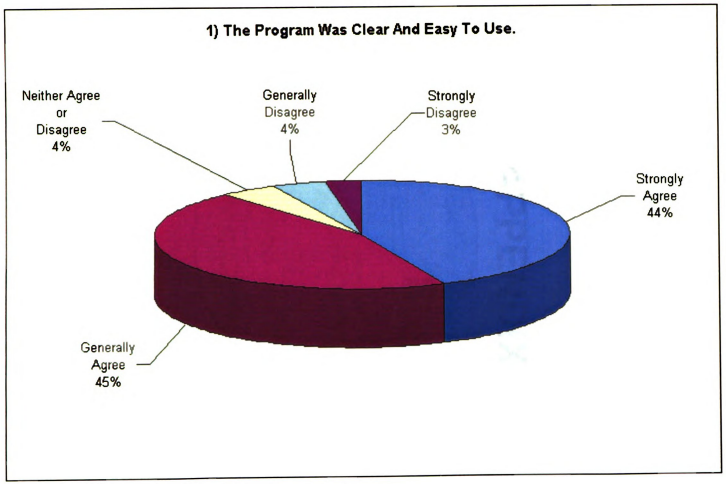
8) I had trouble understanding the concepts before I saw the program. ___

(Please write any additional comments on the back of this sheet)

Comments

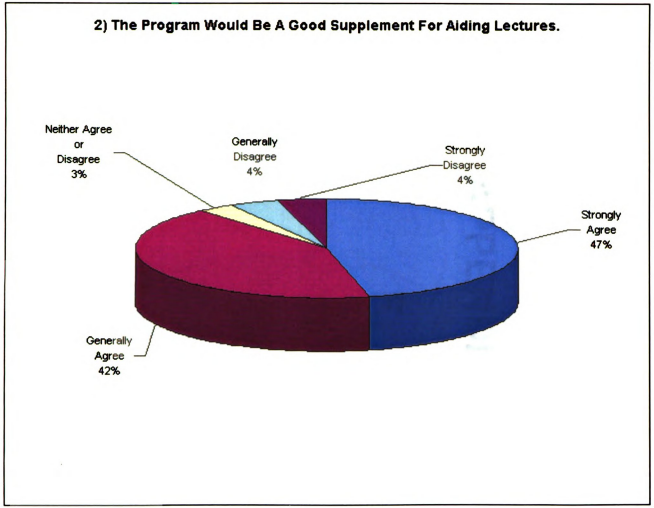
APPENDIX

D


1) The Program Was Clear And Easy To Use.
Neither Agree or Disagree 4%
Generally Disagree 4%
Strongly Disagree 3%
Strongly Agree 44%
Generally Agree 45%

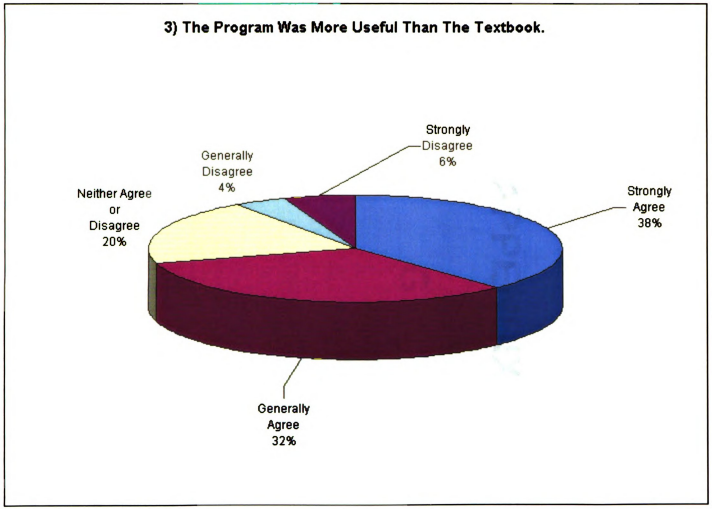
APPENDIX

E


2) The Program Would Be A Good Supplement For Aiding Lectures.
Neither Agree or Disagree 3%
Generally Disagree 4%
Strongly Disagree 4%
Strongly Agree 47%
Generally Agree 42%

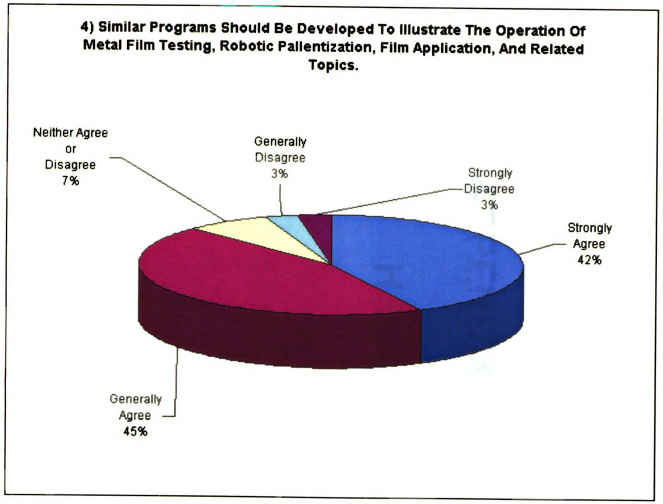
APPENDIX

F


3) The Program Was More Useful Than The Textbook.
Strongly Disagree 6%
Generally Disagree 4%
Neither Agree or Disagree 20%
Strongly Agree 38%
Generally Agree 32%

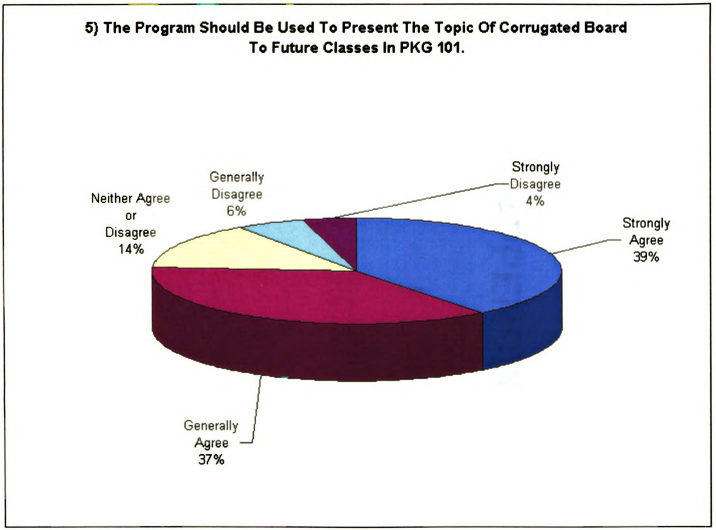
APPENDIX

G


4) Similar Programs Should Be Developed To Illustrate The Operation Of Metal Film Testing, Robotic Pallentization, Film Application, And Related Topics.
Neither Agree or Disagree 7%
Generally Disagree 3%
Strongly Disagree 3%
Strongly Agree 42%
Generally Agree 45%

APPENDIX

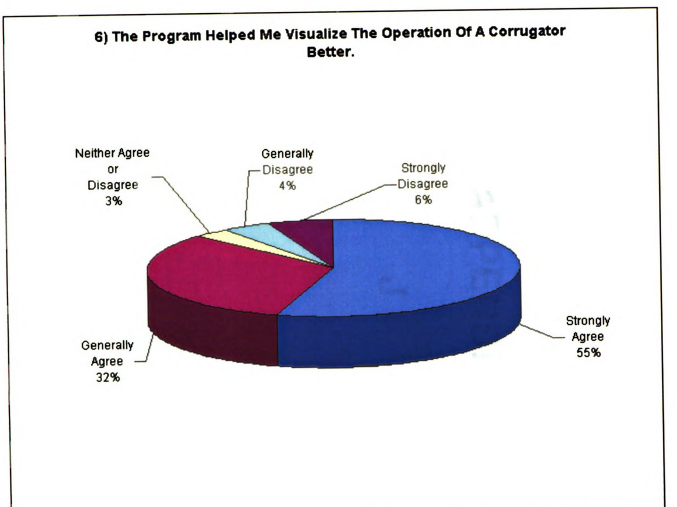
H


5) The Program Should Be Used To Present The Topic Of Corrugated Board To Future Classes In PKG 101.
Strongly Disagree 4%
Strongly Agree 39%
Generally Agree 37%
Neither Agree or Disagree 14%
Generally Disagree 6%

5) The Program Should Be Used To Present The Topic Of Corrugated Board To Future Classes In PKG 101.

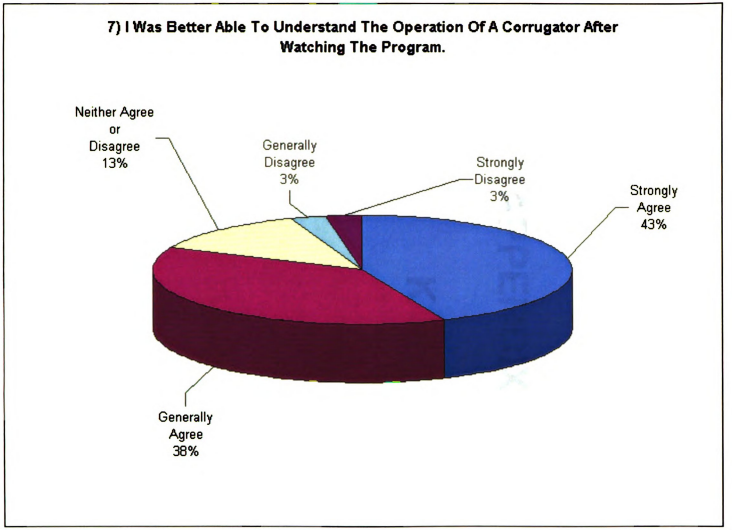
APPENDIX

I


6) The Program Helped Me Visualize The Operation Of A Corrugator Better.
Neither Agree or Disagree 3%
Generally Disagree 4%
Strongly Disagree 6%
Strongly Agree 55%
Generally Agree 32%

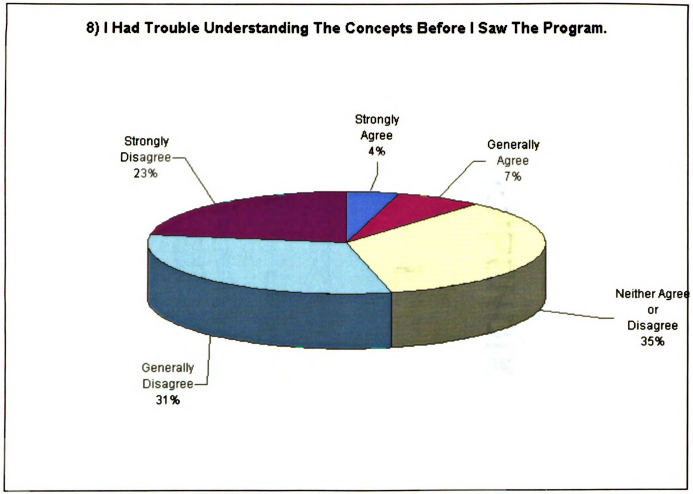
APPENDIX

J


7) I Was Better Able To Understand The Operation Of A Corrugator After Watching The Program.
Neither Agree or Disagree 13%
Generally Disagree 3%
Strongly Disagree 3%
Strongly Agree 43%
Generally Agree 38%

APPENDIX

K


8) I Had Trouble Understanding The Concepts Before I Saw The Program.
Strongly Agree 4%
Generally Agree 7%
Strongly Disagree 23%
Neither Agree or Disagree 35%
Generally Disagree 31%

6) I Had Trouble Understanding The Concepts Before I Saw The Program.

APPENDIX

L

CD-ROM REFERENCE

A copy of the final presentation on CD-ROM is available from the graduate secretary at the School of Packaging, Michigan State University.

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